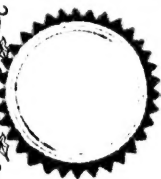


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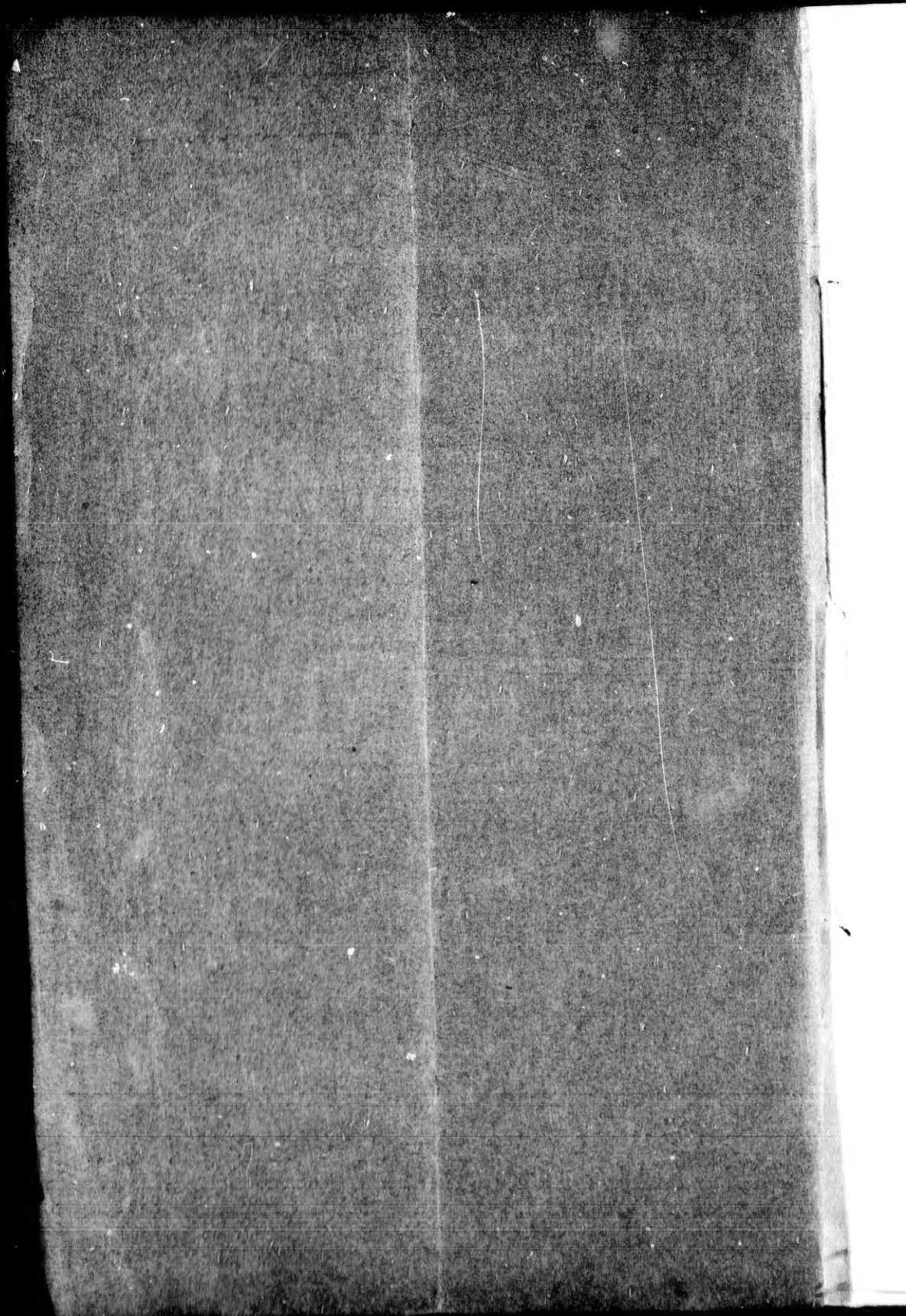
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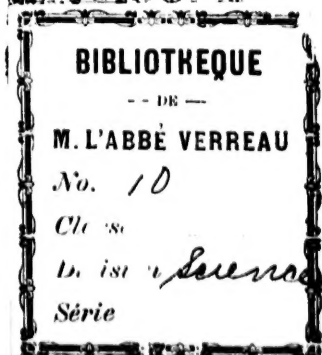
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THE BAROMETER.

A little more than two centuries have now elapsed since a pump was sunk at Florence for the purpose of raising water from an unusually great depth, resulting in the discovery that despite all the ingenuity which the operatives could then exercise, the water would not rise higher than about 32 feet. The celebrated Galileo was consulted about the phenomenon, but he failed to assign a reason for it. It nevertheless set that philosopher, and his no less celebrated pupil Torricelli upon a train of ideas which resulted in the discovery of the barometer. The latter substituted mercury for water in some of his experiments, and he found that "nature's horror of a vacuum," which in water extended to about 32 feet, did not exceed 30 inches with regard to the latter fluid metal. Hence he justly concluded that both the water and the mercury in their respective heights, exerted the same influence against the atmospheric pressure, and that the counterbalance was of course equal, while subsequent philosophers gave to the vacuum or void which was observed above the mercurial column, when sustained in tubes longer than 30 inches, the name of the Torricellian vacuum—the most perfect vacuum or void obtainable by human means. The Florentine Professor communicated his discovery to Viviani who repeated the experiment in 1643, although he withheld the divulgence of the results for two years. At length Torricelli died, but his place was worthily supplied by Blaise Pascal. In 1646 Pascal, who was renowned as much for his piety as his learning, performed Torricelli's experiment before a large audience at Rouen. He further resolved to test the effect of high or elevated situations upon the height of the mercurial column. It was a bold idea but skilfully carried out. It was the *experimentum crucis*, in the language of the Baconian philosophy, the one which

was to decide, the entertained but glimmering idea, that the mercury was sustained in its height by the pressure of the atmosphere. Pascal, whose ill health at the time prevented him from attempting the experiment, communicated his thoughts to his relative Berier at Auvergne, and the latter at once set about performing it. This event occurred on the 19th September, 1648. The mercury stood at 28 inches in the lowest part of Clermont in the garden of the Pères Minimes. The tube was then carried to the summit of a neighbouring mountainous peak, the Pûy de Dôme, elevated above the former situation about 529 toises, and on being examined it was found to have fallen $3\frac{1}{10}$ inches, while on gradually descending the sides of the mountain, the mercurial column was observed gradually to rise, until having arrived at the spot from which they started, it was found to have regained its primitive elevation. Nothing could have been more conclusive than this experiment, as it demonstrated in the clearest possible manner that the mercurial column was sustained in its height by the pressure of the atmosphere. The experiment was afterwards repeated by Pascal himself in Paris, by taking a tube to the top of a high tower in that city. It was further noticed that by keeping the tube for a length of time in a fixed position, the height of the column was found to vary from day to day within certain small limits, an effect which could only be ascribed to fluctuations in the weight of the atmosphere itself. Since that period the experiment adverted to, has been performed numberless times both on the old and new continents; and no fact in science is at the present day more clearly recognized, than that the height of the mercurial column is a true index of the pressure of the atmosphere, which it exactly counterbalances in weight in proportion to its diameter, and that this height varies with alterations in that pressure. It was not however until six years after the performance of these experiments that our own countryman Boyle applied a column of mercury to the purposes of meteorology.

The simple apparatus devised by Torricelli, consisting of a tube containing mercury, of at least 30 or 32 inches, dipping into a cistern containing an additional quantity of the same metal, is in fact a barometer, a name subsequently given, and composed of two

Greek words signifying "measure of weight," (*barus, metron*). And although it has been distorted into endless varieties of shapes, and received numerous additions, yet they have been all abandoned one after the other, and the simple form in which Torricelli first observed the effect of the pressure of the atmosphere in sustaining the column of mercury, is now universally admitted to be the best form for noting the fluctuations in atmospheric pressure which are daily, nay hourly, taking place. This is the principle of the instrument, upon which nothing can improve. In point of permanent utility an instrument so constructed far excels the Aneroid barometer, the invention during the year 1848 of an ingenious Frenchman, Mr. Vidi, because its construction is based upon one of the immutable laws of nature. So constructed, it is in reality, if I be permitted so to speak, a balance or pair of scales, of the most delicate nature, in which a column of atmospheric air of the height of about 45 miles, sustains a column of mercury of its own diameter at the base of about $28\frac{1}{2}$ inches in height, the minutest variations in the height of the one column producing corresponding variations in that of the other, which by a properly adjusted apparatus—by no means necessary for the ordinary purposes of life—may be read to the thousandth part of an inch. Such minuteness is, however, as I have remarked, not needed for the ordinary purposes of life, although for scientific purposes it is imperative; but whatever additions to the instrument have been made for purposes of science, in all the instruments, no matter where they may have been manufactured, the principle before alluded to, has never for one moment been lost sight of, nor could it without nullifying the instrument.

As regards the theory of the barometer we may make the following observations; that as the column of mercury exactly counterbalances the column of atmospheric air of its own diameter at the base, so any causes which disturb the height of that column of air, or add to its own specific weight, must necessarily produce a corresponding alteration in the height of the mercurial column; and experience has amply confirmed what theory would lead us to expect on this point. High winds, therefore, materially affect its altitude, but especially does the absorption of moisture, or the vapour of water. Water, except in extremely wet weather, is

continually evaporating from the surface of the earth, and becomes absorbed, so to speak, by the atmosphere, with which it combines mechanically, and in an invisible form. So long as this state of invisibility of the vapour in the atmosphere is continued, the specific weight or gravity of the atmosphere continues to increase, and at no time does the mercurial column stand higher, than in what is technically called "fine dry weather;" but as it is well known, that nothing is required to convert this invisible vapour into a visible and substantial form, that of water, than a reduction of temperature, so, in the upper regions of the atmosphere, those portions of it charged with an undue amount of vapour meeting colder strata, have that excess of vapour at once converted into little globules or films of water, which coalescing form the clouds which eventually drop their contents in the form of rain, snow or hail, in accordance with the temperature nearer the surface of the earth. It would thus appear that we may have two opposite atmospheric conditions, one which renders the vapour of water invisible, or what may be called an absorbing atmosphere, and another which renders that vapour visible, or what may be called a condensing one, and it is these two conditions which the barometer indicates with such prophetic exactitude, under the former condition the mercurial column usually rising, and under the latter, falling.

Some few facts in regard to the barometer deserve to be mentioned. Barometers as usually sold have the words Fair, Rain, Stormy, &c., placed on the scales of the instruments. Trusting to these signs the observer would be deceived. It is the steady observance of the elevation and depression of the column over a given height which constitutes its excellence. Changes in its height indicate changes in atmospheric density, and consequently in the weather—present rather than prospective. Any sudden change indicates an approaching variation of the weather, though one of short continuance; a gradual change indicates the same but of longer duration. A rapid depression is most commonly followed and speedily too, by a tempest, whose fury may be spent at the place of observation, or at the distance of some miles from it. What more beautiful exposition of the value of the readings of this instrument when made by an attentive and watchful eye,

than the warning of Admiral Fitzroy, last winter, to mariners sailing from the chief western ports of England. The predicted and forewarned hurricane came on with all its fearfully-told tale of disasters, which would have been most awfully augmented, had not many commanders of vessels, who did not lay claim to the same amount of wisdom as their neighbours, listened to the still small voice of "caution." The delay in the day of sailing from the port of Liverpool alone, in this instance, saved thousands, perhaps millions of pounds worth of property. It is a singular fact that with reference to storms and their usually dreaded effects, we have the most benefit from the barometer when it is most required. It is exactly at those times, when everything around bespeaks the continuance of fine weather, when the sky is cloudless, and the air disturbed but by the mildest zephyrs, that this valuable instrument raises, to use a metaphor, its finger in warning attitude. Let us suppose the husbandman ready to reap his fields of "bending corn," and rejoicing in the abundance of the harvest with which an Almighty Father had blessed his toil. The reaping and stacking, &c., of the cereals is an operation requiring the labour of several days, and for its success a continuance of the finest weather. The intelligent farmer, who has been carefully reading and watching the indications of his barometer, has observed for a day or two, a trifling but nevertheless steady fall in the height of the mercurial column. He postpones his intended field-work. Within a period of time varying from 24 to 48 hours most usually after the phenomena before observed had been witnessed, a fearful storm, partaking possibly of the character of a hurricane may have passed over the land,—but his stock has been saved because still standing. In fact there is such constancy in the indications of this instrument, that to the agriculturist we regard it almost as invaluable as his spade or plough. We know no class of society to which the indications of any instrument are of such supreme importance as are those of the barometer to the farmer, and all that surprises us is, that these instruments are not more commonly employed by them, as the guide to their out-door or field-work when gathering in their crops. Were it more generally used, there cannot be the least doubt, that the crop on many a fine field of wheat would have been saved from destruction or damage by its subsequent exposure to wet or damp.

A few remarks in regard to the general indications of the barometer will conclude these observations on the utility of it.

The rising of the mercury generally indicates fair as its descent foretells rainy weather. If the barometer be high in winter, frost may be expected; and if during frost it rises, snow will follow; if it falls, there will be a thaw. If it falls rapidly in hot weather, thunder is foreboded. Rapid fluctuations indicate unsettled weather. In Montreal the barometer commonly rises with a West and North wind, and sinks with an Easterly or Southerly one. There may be a difference on this point in the more Westerly places of the Province. The barometer oscillates most in variable winds from a very obvious cause, and this has been mainly observed about the equinoxes. It is more stationary in summer than in winter, and has been observed to have periodical daily tides. If the sky is clouded and the barometer low, showers will fall; if overcast, and the mercury high, it will not rain. Anomalous descents not attended or followed by corresponding atmospheric mutations result generally from distant contemporaneous storms. With these general remarks on the value of the indications of the barometer, we cannot do better than conclude with giving the following rules for observing this instrument as taken from Prof. Silliman's lectures.

1. The sudden fall of the mercury is usually followed by high winds and storms.
2. The rising of the mercury indicates generally the approach of fair weather; the falling shows the approach of foul.
3. In sultry weather the falling of the mercury indicates coming thunder. In winter a rise indicates frost. In frosty weather a fall indicates thaw: a rise, snow.
4. Whatever change of weather follows a sudden change in the barometer, may be expected to last but a short time.
5. When the barometer alters slowly, a long continuation of foul weather will succeed if the column falls, or of fair weather if the column rises.
6. A fluctuating and uncertain state of the barometer indicates changeable weather.

RECOMMENDATIONS.

From CHARLES SMALLWOOD, M.D., LL.D.

OBSERVATORY, ISLE JESUS, C. E.,
20th July, 1861.

Sir,—I have carefully examined the construction of the two Mercurial Barometers you left with me, and can testify to the purity of the mercury and the efficient manner in which the tubes are filled, *two most important points* in the making of Barometers.

The adoption of the Stop-cock to cut off the column of mercury, furnishes a ready and safe means of transport, which is not to be found in any of the Mercurial Barometers now made.

The attached Thermometer is graduated to suit our climate, and will be found useful as an indicator of the temperature.

I have also compared their readings with the *Standard Barometer*, and have found them to coincide to a great nicety with the standard instrument.

I can with confidence recommend them to any person engaged in pursuits where the changes of weather may be of consequence; to Farmers, Schools and Colleges, an instrument of the kind is indispensable, and the low price at which you furnish them must be an inducement to place them in the hands of all such parties.

As an indicator of the changes in the weather the Mercurial Barometer is regarded as the best and most reliable instrument.

CHARLES SMALLWOOD.

Mr. J. Wescott, Montreal.

RECOMMENDATIONS.

From ARCHIBALD HALL, M. D., Montreal.

MONTREAL, June 29, 1861.

MY DEAR SIR,—You have exhibited to me, and permitted me to examine and compare with my standard barometer constructed upon Barrow's English Patent, a barometer manufactured by yourself in this city. After a great many observations of its working, I have only to observe that it has proved itself faultless in its indications, and it may therefore be considered as a perfectly trustworthy instrument in every respect.

The simplicity of its construction, its portability, or rather the means by which it is rendered so, in this respect far surpassing all the barometers which I have yet seen, and the cheapness of its price, all highly recommend it to general favour.

The indications of this truly useful instrument should be the guide to the out-door operations of every agriculturist, as it enables him by a very little observation of its movements to foretell the approach of weather unfavourable to his field-work, and the price demanded for it must unquestionably place it within the reach of every one engaged in such pursuits. It is indeed rather a matter of surprise to me that such an instrument is not in general use among our population of that class, but probably the price hitherto demanded for reliable instruments of this kind may have precluded their purchase generally, as none but the more affluent in their circumstances could command them. The prices affixed to your instruments, however, are such as to place them within the reach of every farmer, however limited in means he may be, and if he would only attend to the alternations in the height of the column, as specified in the pamphlet which you gave me, and which I understand accompanies the instrument, there cannot be the least doubt that the trifling outlay in its purchase would be more than abundantly returned in the saving of his crops which would become necessarily effected through its timely warnings.

I cannot regard your sojourn among us for the purpose of manufacturing these instruments, in any other light than as an acquisition to the Province, and I do trust that while it will not prove unproductive of benefit to yourself individually, you may be the means of benefiting most materially our agricultural interests.

I remain,

Yours very faithfully,

A. HALL.

Mr. J. Wescott,
&c., &c., &c.

Extract of a letter from HENRY WARD BEECHER.

While visiting in the country, and published in the *New York Independent*.

It is five o'clock. * * * A hundred birds, yes, five hundred, are singing as birds never sing except in the morning. A few chimneys send up a slow wreathing column of smoke, which grows every moment paler as the kindled fires below burn brighter. * * * The clouds hang low on the mountain on every side. Their ragged edges comb the mountain side, and look as if they must sway the trees in their course. Yet they move with such soft and drowsy measure that not a leaf stirs. Will there be rain to-day? The heavens overhead look like it. The clouds around the mountain hang low as if there were rain coming. But the Barometer says, *No*. Then a few rounds with the scythe before breakfast. * * We must make hay while the sun shines. * * The day passes and the night. With another morning, and that Saturday morning, comes up the sun without a single cloud to wipe his face upon. The air is clear and crystal—no mist is on the river, no fleece upon the mountain, yet the barometer is sinking and has been sinking all night. It has fallen more than a quarter of an inch, and continues slowly to fall. Our plans must be laid accordingly. We will cut the clover which is to be cured in the cock, and prepare to get in all of yesterday's mowing before two o'clock. Not till about ten o'clock is any change seen. Then the sun's light seems pale, and, although no cloud is before it, some invisible vapor has struck through the atmosphere. By-and-by the clouds begin to form, loose, vast, cumbrous, that slowly roll and change their unwieldy shapes, and take on every shade of color that lies between the darkest leaden-gray and the most brilliant silver gray. While catching our hasty meal, affairs grow critical. The sun is hidden. The noon is dark. All hands are summoned. * * * All the girls and ladies come forth to the fray. Delicate hands are making lively work, raking up the dispersed grass and flying with right nimble steps here and there, bent on cheating the rain of its expected prey; and now the long winnows are formed. The last load of hay from the other fields has just rolled triumphantly into the barn. * * * A drop pats down on my face, another and another. Look at those baseless mountains that tower in the west, black as ink at the bottom, glowing like snow at the top edge—what gigantic evolutions! They open, unfold, change form, flash lightning through their space, close up their black gulfs, and move on with irresistible but silent march through the heated air. Far in the north the rain has begun to sheet down upon old Gray-Lock! But the sun is shining through the shower, and changing it to a golden atmosphere, in which the mountain lifts up his head like a glorified martyr amid his persecutions! only one look can we spare, and all of us run for the house, and in good time. Down comes the flood, and every drop is musical. We pity the neighbors, who, not warned by the barometer, are racing and chasing to save their outlying crops.

From PROF. SILLIMAN.

The fall of mercury warns the mariner to put his ship in trim for a storm, and conveys the same kind of information to a farmer; and enables him seasonably to provide for unfavorable changes in the weather, by housing his animals and protecting his crop.

The late Dr. DICK, LL.D., *Christian Philosopher, &c., &c.*, says:—By the use of the barometer, the farmer is warned of approaching storms, and thereby enabled to protect his produce from danger.

From PROF. JOSEPH HENRY, *Smithsonian Inst., Washington.*

In relation to barometers, to practical farmers, they serve to warn the farmer to make preparations for the weather, which might be injurious to his crops or stock.

Extract of a letter from HON. SIMON BROWN, Editor of the New England Farmer, Feb. 25th, 1860.

A FARMER'S BAROMETER.

As great as the value of the barometer is acknowledged to be to the navigator, a little reflection and investigation will satisfy many that its common use will be of scarcely less importance to the tiller of the soil. Let us bring to our aid, for a moment, the omnipotence of figures, and see what revelations they will unfold. The United States Census of 1850, gives the valuation of the agricultural products of the country, (but only including that portion of the crop which is easily damaged by getting wet while being harvested,) at more than *nine hundred and fifty millions of dollars!* It is supposed to be a fair estimate, by good judges, that there is an average loss of *five* per cent. on all the crops harvested in the country, because most crops that are injured by storms or by a succession of damp and cloudy days, are injured much more than five per cent., so that the average on the whole may be fairly set down at that sum. If the value of the barometer, in the hands of observing and intelligent farmers is not over-estimated by the most scientific men of this and other countries—such men as Dr. ARNOT, PROF. SILLIMAN, Dr. DICK, PROF. HENRY, PROF. MACRY, and others—it is fair to suppose that a large proportion of this loss might be prevented, and thus, a gain made to the farming community of about *fifty millions of dollars* annually! Another item worthy of consideration is, the increased cost of harvesting a damaged crop. If by the general use of the barometer this could be prevented, another sum of startling magnitude in the aggregate might be saved.

The little, unpretending barometer, hanging in the saloon of one of our splendid ocean steamers, warns the watchful pilot of an approach of an impending iceberg, even amid the gloom of the darkest night! Why may not its admonitions be of equal value to as much property exposed to the elements on the land, and teach us to shun the losses which annually depreciate the profits of the farm?